

बेवेल प्रोट्रेक्टर — विशिष्टि
(दूसरा पुनरीक्षण)

Bevel Protractors — Specification
(Second Revision)

ICS 17.040.30

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Engineering Metrology Sectional Committee had been approved by the Production and General Engineering Division Council.

This standard was first published in 1967 and subsequently revised in 1970. In the first revision, 200 mm blade size was added. The second revision has been taken up to keep pace with the latest technological developments and international practices.

The major changes in this revision are as follows:

- a) Amalgamation of IS 5812 : 1970 'Specification of optical bevel protractor'.
- b) Addition of the requirements of digital bevel protractor.

The composition of the committee, responsible for the formulation of this standard is listed in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard***BEVEL PROTRACTORS — SPECIFICATION***(Second Revision)***1 SCOPE**

This standard specifies the requirements of:

- a) mechanical or optical bevel protractors with vernier scale or circular scale (dial); and
- b) digital bevel protractors.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute

provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 NOMENCLATURE

For the purpose of this standard, the nomenclature given in Fig. 1, Fig. 2 and Fig. 3 shall apply.

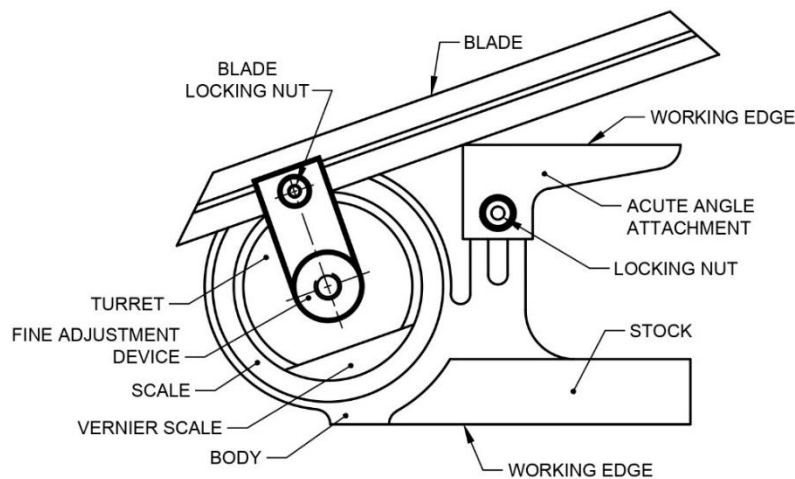


FIG. 1 MECHANICAL BEVEL PROTRACTOR

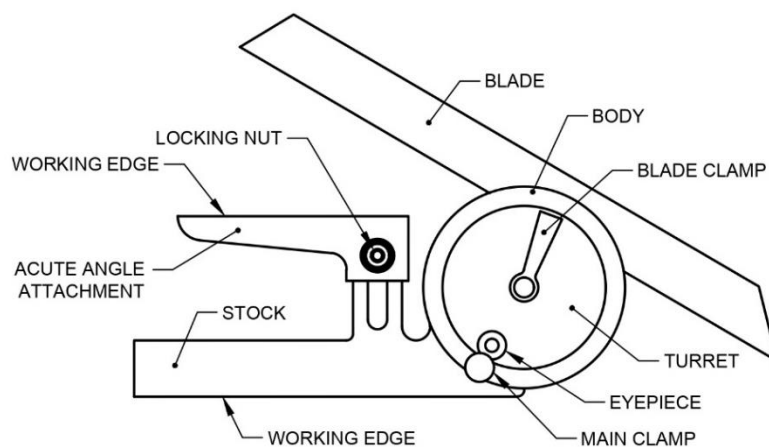


FIG. 2 OPTICAL BEVEL PROTRACTOR

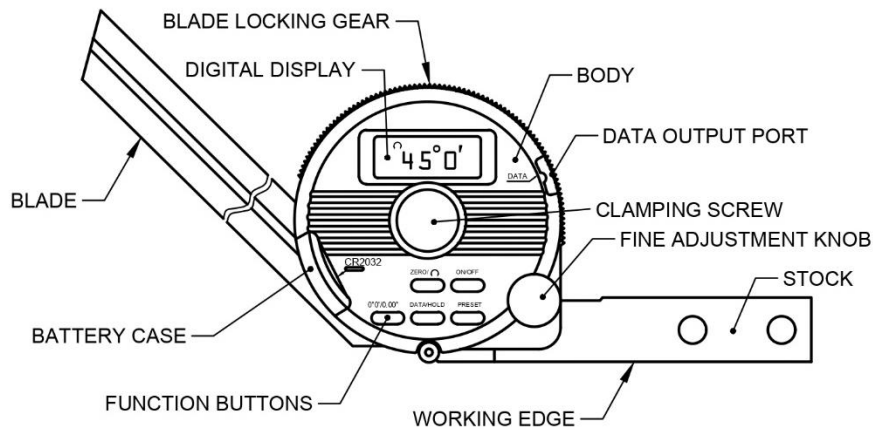


FIG. 3 DIGITAL BEVEL PROTRACTOR

4 CONSTRUCTION

4.1 Mechanical Bevel Protractor

4.1.1 Mechanical bevel protractors are provided with one or more of the following:

- a) Vernier scale;
- b) Fine adjustment device; and
- c) Acute angle attachment.

4.1.2 Types

In order to facilitate designation, the mechanical bevel protractors are classified into four types as described below:

- a) Type A — Bevel protractor provided with a vernier graduated to read to 5 minutes of arc and also with a fine adjustment device and acute angle attachment.
- b) Type B — Bevel protractor provided with vernier graduated to read to 5 minutes of arc and an acute angle attachment but without fine adjustment device.
- c) Type C — Bevel protractor provided with vernier graduated to read to 5 minutes of arc but without fine adjustment device or acute angle attachment.
- d) Type D — Bevel protractor graduated in degrees and is not provided with either vernier or fine adjustment device or acute angle attachment.

4.2 Optical Bevel Protractor

In the type of bevel protractors covered in this standard, provision is made for an internal circular scale which is graduated in divisions of 10 minutes of arc and read against a fixed index line or vernier by means of an optical magnifying system integral with the instrument, enabling readings to be taken by estimation or otherwise, to approximately 2 minutes of arc.

5 MATERIAL

The working parts of the bevel protractor shall be made of stainless steel.

6 HARDNESS

The blade of the bevel protractors shall have a hardness of 650 HV to 700 HV [see IS 1501 (Part 1)].

7 DIMENSIONS

7.1 Stock

The working edge of the stock shall be not less than 90 mm long and shall have a thickness of not less than 7 mm.

7.2 Blade

The blade shall be either 150 mm or 200 mm or 300 mm long, and shall be not less than 13 mm in width and not less than 2 mm in thickness. The ends of the blade shall be bevelled to 60° and 45° as shown in Fig. 4.

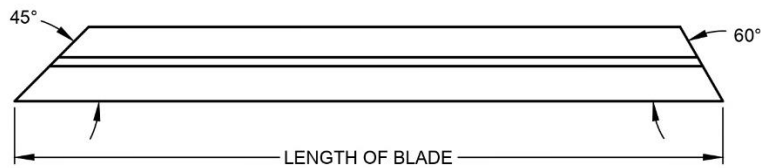


FIG. 4 BEVELLING OF BLADE

7.3 Scale

The scale dial shall not be less than 65 mm and not more than 75 mm in diameter.

7.4 Acute Angle Attachment

The working edge of the acute angle attachment shall not be less than 75 mm long and the thickness shall correspond to that of the blade.

8 GENERAL REQUIREMENTS

8.1 Body

The bevel protractor shall be so designed that the back of the body is flat and that there are no projections beyond the plane of the back of the bevel protractor. When the protractor is placed on its back on a surface plate, there shall be no perceptible rock.

8.2 Blade

The blade shall be so designed that it is possible to move it along the turret throughout its whole length, and also be reversed. An effective method of clamping shall be provided.

8.3 Acute Angle Attachment

This shall be so designed as to fit readily on the body. It shall be capable of being clamped at any desired point, within the limit provided, in the base.

8.4 Clamping

Thumb nut or any other suitable clamping device shall be furnished for locking the turret to the body.

9 ACCURACIES

9.1 Body

When the bevel protractor is placed on the working edge of the stock on a surface plate and the blade set at 90°, the side of the blade and the back of the bevel protractor body shall be square laterally with the surface plate to within 0.03 mm per centimetre.

9.2 Stock

Any departure from true straightness of the working edge shall be in the nature of a concavity, the extent

of which shall not exceed 0.01 mm when measured over the total span of the surface concerned.

9.3 Blade

The accuracies for the blade shall be as per Table 1.

9.4 Acute Angle Attachment

Where provided, the working edge shall be straight to within 0.005 mm and according to the type of the attachment, shall be parallel with, or square to, the working edge of the stock to within 0.015 mm over the length of the attachment in all its positions.

9.5 Error of Readings

9.5.1 The total error of indication in any position of the blade of Types A, B and C mechanical bevel protractors shall not exceed ± 5 minutes of arc.

9.5.2 The total error of indication in any position of the blade of Type D mechanical bevel protractors shall not exceed ± 12 minutes of arc.

9.5.3 The total error of indication of an optical bevel protractor in any position of the blade shall not exceed ± 2 minutes of arc.

9.5.4 The total error of indication of in any position of the blade of digital bevel protractors shall not exceed ± 2 minutes of arc.

10 GRADUATIONS

10.1 Mechanical Types

10.1.1 The scale shall be graduated either as a full circle marked 0-90-0-90 (four quadrants) with one vernier, or alternatively as a semicircle marked 0-90-0 with two verniers 180° apart. All verniers shall read in both directions. One of the zero position shall be indicated when the blade is parallel to the stock (Fig. 5).

10.1.2 All graduations shall be clearly engraved. The thickness of the graduations shall be between 0.05 mm and 0.07 mm. For any one bevel protractor the thickness of the graduations of the vernier and main scale shall be equal as observed by the eye.

Table 1 Accuracies for the Blade
(Clause 9.3)

SI No.	Size of Blade	Tolerance			Angular Tolerance for Bevelled Ends in Minutes of Arc
		Flatness of Blade	Straightness of Working Edges	Parallelism of Working Edges	
	mm	µm	µm	µm	
(1)	(2)	(3)	(4)	(5)	(6)
i)	150	150	10	15	± 5
ii)	200	200	15	20	± 5
iii)	300	300	20	30	± 5

10.1.3 The visible length of the shortest graduations on both the scale and the vernier (dimension *L*, Fig. 6) shall be approximately equal to twice the width of the interval between adjacent graduations.

10.1.4 The distance from the graduated face of the scale to the face of the vernier (dimension *T*, Fig. 5) shall not exceed 0.1 mm.

10.1.5 The bevel protractors with vernier shall be graduated to read direct to 5 minutes of arc.

10.1.6 The bevel protractors without vernier shall be graduated in degrees.

10.2 Optical Type

10.2.1 The scale shall be graduated as a full circle marked 0 - 90 - 0 - 90 (four quadrants). The zero positions shall be indicated when the blade is parallel to the stock. The acute angle reading shall then be zero or 90° according to the type of acute angle attachment, when fitted.

10.2.2 All graduations shall be clearly defined. The thickness of the graduations of the scale and the vernier shall be equal, and between 1 minutes and 2 minutes of arc, as observed through the optical system.

10.2.3 The scale and vernier shall be in focus in the optical system simultaneously.

10.2.4 Provisions shall be made for adjusting the focus of the system to accommodate normal variations in eyesight and the field of view shall be properly illuminated when the instrument is held to the light.

11 FINISH

All exterior surfaces except knurled surfaces of the

bevel protractors shall have a finish such that the surface roughness shall be 1 µm *R_a* value (see IS 3073) or better. The vernier and the main scales shall have a matt finish to facilitate easy reading.

12 DESIGNATION

The bevel protractors shall be designated by the type, size of the blade and the number of the standard.

Example:

- a) A mechanical bevel protractor of Type B with 150 mm blade shall be designated as:

Mechanical Bevel Protractor B 150 IS 4239

- b) An optical bevel protractor with 150 mm blade shall be designated as:

Optical Bevel Protractor 150 IS 4239

- c) A digital bevel protractor with 300 mm blade shall be designated as:

Digital Bevel Protractor 300 IS 4239

13 TESTS

13.1 Flatness

Flatness shall be tested with a dial indicator (see IS 2092), used in conjunction with a surface gauge and surface plate (see IS 2285) or by any other method of equal or greater precision.

13.2 Squareness

The squareness shall be determined with a dial indicator used in conjunction with a surface plate and precision angle block (see IS 2554), or by any other method of equal or greater precision.

13.3 Angular Intervals

Angular intervals shall be determined by means of either a toolmaker's microscope, precision dividing head or dial indicator used in conjunction with a surface plate, sine bar (*see* IS 5359) and slip gauges (*see* IS 2984) or by any other method of equal or greater precision.

13.4 Parallelism

The blades shall be tested for parallelism by means of optical comparators or by any other method of equal or greater precision.

13.5 Straightness

The blades shall be tested for straightness with straight edges (*see* IS 2220) of known accuracy or with a dial indicator and reference precision surface plate (*see* IS 2285).

14 MARKING

14.1 Each bevel protractor shall have legibly and

permanently marked upon it, in characters not less than 1 mm high, the type, the nominal size of the blades, and the accuracy of reading and manufacturer's name or trade-mark.

14.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

14 PACKING

Each bevel protractor shall be coated with a suitable anti-corrosive coating and shall be wrapped in a moisture-proof paper or any other suitable wrapping material. The bevel protractor shall then be supplied in a suitable protective case.

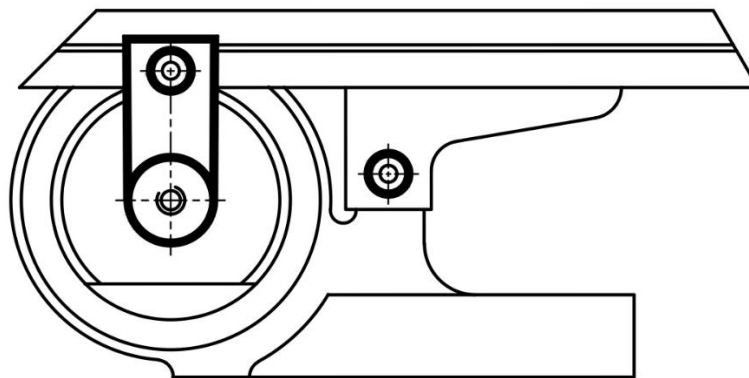


FIG. 5 ZERO POSITION

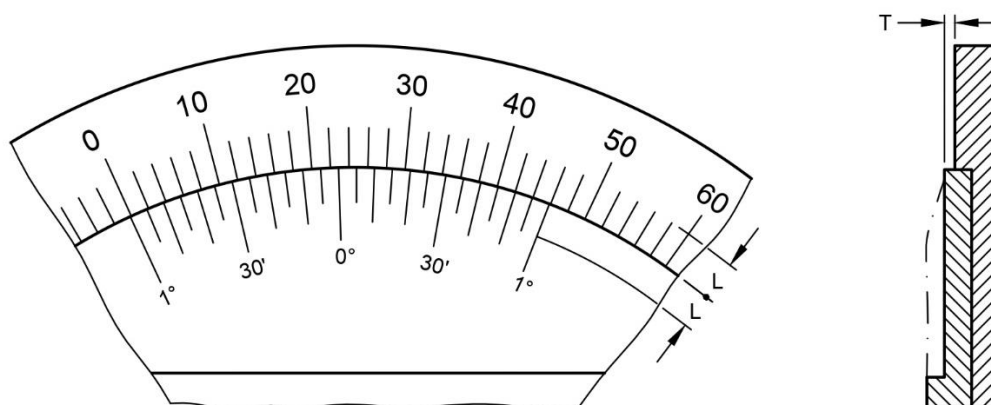


FIG. 6 SCALE AND VERNIER

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
IS 1501 (Part 1) : 2020/ISO 6507-1 : 2018	Metallic materials — Vickers hardness test: Part 1 Test method (<i>fifth revision</i>)	IS 2554 : 1971	Specification for cast iron angle plates (<i>first revision</i>)
IS 2092 : 1983	Specification for plunger type dial gauges (<i>first revision</i>)	IS 2984 : 2003/ ISO 3650 : 1998	Slip gauges — Specification geometrical product specifications (GPS) — Length standards gauge blocks (<i>second revision</i>)
IS 2220 : 1990	Engineering metrology — Steel straightedges — Specification (<i>first revision</i>)	IS 3073 : 1967	Assessment of surface roughness
IS 2285 : 2003/ ISO 8512-1 : 1990	Engineering metrology — Measuring equipment — Cast iron surface plates — Specification (<i>third revision</i>)	IS 5359 : 1987	Specification for sine bars (<i>first revision</i>)

ANNEX B*(Foreword)***COMMITTEE COMPOSITION**

Engineering Metrology Sectional Committee, PGD 25

<i>Organization</i>	<i>Representative(s)</i>
CSIR - National Physical Laboratory, New Delhi	DR RINA SHARMA (<i>Chairperson</i>)
Accurate Engineering Company Private Limited, Pune	SHRI ADITYA SALUNKE SHRI ASLAM R. SAYYED (<i>Alternate</i>)
Advance Measuring Systems, Kohlapur	SHRI VIKRAM SAWANT
Automotive Research Association of India, Pune	SHRI M. S. KURANE SHRI PRAVIN WADEKAR (<i>Alternate</i>)
Bagson Calibration Lab Private Limited, New Delhi	SHRI M. L. BAGGA SHRI VIVEK BAGGA (<i>Alternate</i>)
Baker Gauges India Limited, Pune	SHRI ANIS S. KARMAWALA
Bharat Dynamics Limited, Hyderabad	SHRI V. RAMNARAYAN SHRI KHEMENDRA PATLE (<i>Alternate</i>)
Bharat Heavy Electrical Limited, New Delhi	SHRI M. CHANDRA SEKHAR
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Emm Tech Calibration, Faridabad	SHRI RAJESH DESWAL
Kudale Calibration Laboratory Private Limited, Pune	SHRI C. M. PUNTAMBEKAR
Mikronix Gauges Private Limited, Aurangabad	SHRI ABHAY HANCHANAL SHRI SUDARSHAN BUBANE (<i>Alternate</i>)
Mitutoyo South Asia Private Limited, New Delhi	SHRI SHAILENDRA KUMAR SINGH SHRI HARRISH BAJAJ (<i>Alternate</i>)
National Accreditation Board for Testing and Calibration Laboratories, Gurugram	SHRI AVIJIT DAS SHRI NAVEEN JANGRA (<i>Alternate</i>)
Octagon Precision (India) Private Limited, Pune	SHRI VIVEK N. GHODKE SHRI MOHAN G. KALE (<i>Alternate</i>)
Oil Industry Safety Directorate, Noida	SHRI MURARI MOHAN PRASAD SHRI N. K. PANDEY (<i>Alternate</i>)
Reliance Calibration Laboratory, Pune	SHRI H. N. PATIL
Size Control Gauges & Tools Private Limited, Pune	SHRI ASHOK SHANKAR DURVE SHRI ATUL ASHOK DURVE (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
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In Personal Capacity (<i>Old Rangpuri - Mehipalpur Road, Rangpuri, New Delhi - 110037</i>)	PROF K. P. CHAUDHARY
In Personal Capacity (<i>S9/402, Sunparadise phase 2, Sun City road, off Sinhgad road, near fire station, Pune - 411051</i>)	SHRI O. M. MODAK
BIS Directorate General	SHRI R. R. SINGH, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (PRODUCTION AND GENERAL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRI KRISHNA SUDHEENDRAN
SCIENTIST 'C'/DEPUTY DIRECTOR
(PRODUCTION AND GENERAL ENGINEERING), BIS

Panel for Measuring Equipment, PGD 25/P2

<i>Organization</i>	<i>Representative(s)</i>
Mitutoyo South Asia Private Limited, New Delhi	SHRI SHAILENDRA KUMAR SINGH (<i>Convenor</i>)
Accurate Engineering Company Private Limited, Pune	SHRI ASLAM R. SAYYED
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This Indian Standard has been developed from Doc No.: PGD 25 (19700).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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